

in a quiescent part of that fluid with the velocity in question, would run through a space equal to *ten thousand times the length of its diameter in one second*, and consequently would come into contact with at least *six hundred thousand* different particles of water in that time.

"Hence it appears how inconceivably short the time must be that an individual particle, in motion, of any fluid can remain in contact with any other individual particle, not in motion, against which it strikes in its progress, however slow that progress may appear to us to be through the quiescent mass of the fluid!"

"Supposing the contact to last as long as the moving particle employs in passing through a space equal to the length of its diameter—which is evidently all that is possible, and more than is probable—then, in the case just stated, the contact could not last longer than $\frac{1}{10000}$ part of a second! This is the time which the cannon bullet, flying with its greatest velocity (that of 1,600 ft. per second), would employ in advancing two inches.

"If the cannon bullet be a *nine-pounder*, its diameter will be four inches, and if it move with a velocity of 1,600 feet in a second, it will pass through a space just equal to 4,800 times the length of its diameter in one second. But we have seen that a particle of water moving $\frac{1}{10000}$ of an inch in a second actually passes through a space equal to 10,000 times the length of its diameter in that time. Hence it appears that *the velocity with which the moving body quits the space it occupies* is more than twice as great in the particle of water as in the cannon bullet!"

I am sorry that space does not permit further quotation of this essay, in which the author goes on to show that inequality of fluid temperature is one of the leading phenomena of animal life; that respiration raises the heat in one part, while insensible perspiration cools another; that stimulation of all kinds is accompanied with disturbance of temperature and the consequent motion of particles, which he regards as the life of fluids.

Of course it is not supposed that Rumford, by these ingenious speculations, supplies any mechanical solution of the mystery of *conscious* vitality, but his suggestions have the merit of showing that a vast amount of molecular activity is a demonstrable result of simple well-known facts. He obtains this activity without invoking the aid of those profound assumptions in which the brilliant imaginations of modern mathematicians so luxuriously revel when they reason upon the vibrations, gyrations, &c., of the component particles of interatomic atmospheres.

In spite of all the progress we have made in physical science, these essays, written for the most part during the last century, contain a great deal that is still suggestive and worthy of thoughtful reading both by popular students and experts in physical and social science. This is especially the case in the essay on "The Propagation of Heat in Fluids," reprinted in vol. i. of this work. Many of the conclusions and speculations are now demonstrably erroneous, but some of the suggestions—more particularly those in chap. iii. on the Chemical Action of Light—are worthy of far more attention and investigation than they have yet received. They are avowedly very bold, but the author tells us frankly that their temerity "has not been entirely without design;" that "philosophers may be *enticed* and they may be *provoked* to action," and that he has "endeavoured to use both these methods," even with conscious imprudence, for the purpose of ex-

citing them to further investigation of the subjects for which he has such "passionate fondness."

It will be well if the republication of these essays contribute to the fulfilment of Rumford's enthusiastic wishes.

W. MATTIEU WILLIAMS

THE SILKWORM COCOON

Le Cocon de Soie. Histoire de ses transformations, description des races civilisées et rustiques, production et distribution géographiques, maladies des vers à soie, physiologie du cocon et du fil du soie. Deuxième Edition. (Paris: J. Rothschild, 1875.)

WE have received an advance copy of M. E. Duseigneur-Kléber's monograph, "Le Cocon de Soie," dated for 1875, the get-up of which is calculated at once to arrest attention and excite interest. The 248 quarto pages of clearly printed letterpress containing his information, admirably arranged in methodic form, are accompanied by thirty-seven plates executed in photo-typography, and a map of the world indicating the localities where silkworms are cultivated. Twenty-eight of the plates are devoted to the illustration of the different types of cocoons from different countries, of which as many as 195 are figured from photographs.

Such a work was, he says, quite impossible twenty years ago, and it is only in consequence of diseases that it is possible now. Each district prided itself on the silk it produced, and did not trouble to know what other countries were doing, until the enfeeblement of some and the destruction of other types by disease compelled growers to seek fresh types from a distance, and thus accumulated the information which M. Duseigneur-Kléber has compiled and presented in this attractive form. Many of the types he thinks will probably not be again met with in cultivation, and it is only through noticing and recording facts as they came under his notice during a series of years that his information has been obtained. Looking to the past, he finds that from 1700 the years of disease were 1702, 1720, 1750, 1787, but the chroniclers give no intimation of the character of the disease. In 1810 the "plague" was described by M. Paroletti. The affected worm exhibited small spots all over its body, which were gangrenous, and appeared to be caused by the same disease now known as "Muscardine."

Among the practical points noticed in the first section of the work are the following: That the red or black mulberry produces more vigorous worms than the white; that the old notion of selecting bright-coloured cocoons for breeding has given place to the belief that dull yellow are the best; that the practice of limiting the time of copulation of moths is injurious; that while the worms are making their cocoons, the ventilation of the buildings, too often neglected, is even more important than warmth. The symptoms of the disease known as Pebrine are detailed, but its cause seems to be not known. That its recurrence coincides with unusually wet and cold seasons is established, but whether it results from a parasitic vegetation whose germs are carried in the air is still a subject for experiment. When the external indications are well marked, the silk reservoir is found much diminished in volume. The spots which appear on the skin continue

through successive moultings; the feet become atrophied: if the worm dies, the body dries up without putrefaction; if it lives on to metamorphosis the moth shows all the characters of hydropsy.

M. Duseigneur-Kléber has paid much attention to the method of work performed by the worms in the construction of their cocoons. A healthy worm (in disease they act irregularly) selects a suitable spot for its operations, where there is space for its whole body to move about, supporting itself generally by its two last feet only. Having carefully arranged from twig to twig the outline of its work, its movements quicken, and at the end of three hours the first outer layers of its nest are complete, and the sphere of operations is then limited. At the end of five or six hours the exact form of the cocoon is indicated, still remaining diaphanous and rarely coloured yellow. So far it is easy to watch the worm at work, and it is seen that it holds itself in a semicircle or curved like an S. After a little more work the cocoon loses its transparency, and begins to be coloured. The author, however, by methodically cutting into cocoons continued his observations, and found that the worms never stopped to repair the damages thus caused, but going on uninterruptedly, the layers formed within the cut layer rapidly covered the aperture. Remaining attached by its hind legs, a worm forms its layers in the shape of an 8, changing its position from time to time, generally moving but a short distance, though sometimes turning completely round and continuing on the opposite side of the cocoon. He calculates that, varying according to race, there are from thirty to forty different layers in a cocoon, and the time occupied in its construction is from three-and-a-half to four days. Whatever may be the condition of the outer layers, the innermost coat formed is of the finest thread, and the end towards which the head is turned is the tenderest, thus providing a soft and elastic cradle for its metamorphosis.

The book is especially intended for practical purposes, and contains information as to the outward appearance that may guide a dealer in purchasing cocoons, a special chapter being given to each kind of defect. Not only double cocoons, but cocoons in which three or even four worms have worked together, are mentioned.

In the enumeration of silk-rearing districts, besides the well-known localities of France, Italy, the Austrian Empire, China, and Japan, the following less known are among those mentioned:—California, Mexico, Guatemala, Peru, Brazil, Chili, the Argentine Republic, Algeria, and Armenia. In South America especially increased attention is being paid to silk-production, and it gives promise of becoming a very important industry.

OUR BOOK SHELF

The Straits of Malacca, Indo-China, and China; or, Ten Years' Travels, Adventures, and Residence Abroad. By J. Thomson, F.R.G.S. Illustrated. (London: Sampson Low and Co., 1875.)

MR. THOMSON'S sojourn in the countries with which his book is concerned seems to have extended from 1862 onward, during which time he evidently had plenty of leisure to visit various places on the south-east and east of Asia, extending from Penang to Peking. We can heartily recommend his modest work to anyone

wishing to obtain a fair idea of the social life, scenery, and productions of the districts which he visited, and in which he usually sojourned for some time, including the Malay Peninsula, Siam, Cambodia, Hong Kong, Amoy, Peking, and other coast-towns of China. He also sailed a considerable distance into the interior of China, up the Yang-tse-Kiang, and made a short walking tour into the interior of Formosa. Mr. Thomson put his eyes, his ears, and his camera (for he is an accomplished photographer) to excellent use, so that we do not know any work of the size that conveys a juster and fuller idea of the manners and customs of the various peoples whom he visited. Mr. Thomson makes no pretension to have travelled in the interests of science, but only to be a photographer and an observer of the ways of men. Nevertheless, throughout the work occasional jottings are introduced that may be of interest to the botanist and geologist. Among the very first pages he hazards some conjectures as to the cause of the love of brilliant colours among tropical men, birds, and flowers, which are evidence of some observation and thought. "Perhaps," he says, "our men of science might be able to tell us whether the heat of the oriental sun develops in flowering plants a craving for the absorption of certain colours of the solar spectrum, and for the reflection of others; whether, indeed, the electric affinities of plants in this way are affected by temperature. Can we, in the same way, account for the brilliant plumage of tropical birds, in which homogeneous red, yellow, and blue are very conspicuous, and also for the liking which uncultured Eastern races show for the reds, blues, and yellows."

Mr. Thomson gives some very interesting information about the Chinese, whom he found wherever he went, mingling as managers or factors in the life of every place, always bent on making money, and generally succeeding. He seems to have studied their ways intimately, and gives some very curious facts with regard to the powerful associations, or guilds, into which they band themselves everywhere. His visit to Siam, and the account of his intercourse with the King and other dignitaries, will be found entertaining as well as informing.

One of the most valuable chapters in the book, certainly the most interesting to archaeologists and ethnologists, is Mr. Thomson's account of his visit, in 1866, to the magnificent ruins in Cambodia, probably the grandest, if not the most interesting ruins in the world. The illustrations to this part of the work will give the reader a fair idea of the nature of these ruins, their colossal and beautiful architecture, and their wonderful sculpture, giving evidence of a vigorous and high civilisation, the lapse or obliteration of which is one of the strangest events in the history of the world. We have much to learn yet about the history of these ruins and of the people of which they are almost the only remains. "A richer field for research," Mr. Thomson rightly says, "has never been laid open to those who take an interest in the great building races of the East, than that revealed by the discovery of the magnificent remains which the ancient Cambodians have left behind them." We may expect the French, who are the dominant European race in this quarter, to add considerably to our knowledge of these remains, and to clear up the mystery which lies around them. Indeed, the late unfortunate Lieut. Garnier, in his "Travels in Indo-China," has both with pen and pencil shed much new light on the subject.

To those who don't know much about Formosa and its strange inhabitants, savage and semi-civilised, Mr. Thomson's account of his tour in the island will be found of considerable interest. Appended is a list of the Diurnal Lepidoptera of Siam, collected by Mr. Thomson, and named by Mr. H. W. Bates, F.L.S. Altogether the book is a thoroughly creditable and, we believe, credible one, full of the most interesting information, and valuable for the considerable insight it gives into the life of